Univ. Grenoble Alpes
Université de l'innovation

PhD position

Connecting physical and chemical properties with material appearance

SUBJECT DESCRIPTION: This cross-disciplinary research topic is proposed within the framework of the interdisciplinary project PATRIMALP (Cross Disciplinary Program, IDEX, Université Grenoble Alpes) which brings together research laboratories of the COMUE UGA studying ancient artworks. The main objective of this project is to use ancient materials as records of artistic habits and gestures and to investigate significant traces of the origin of the raw materials, manufacturing processes or degradation over time. This research project is at the intersection of Computer Graphics and Materials Science. The goal is to connect the visual appearance of a material (its color, shininess, transparency) with its physical and chemical properties (exact nature of its constituents, size, morphology and size distribution of grains, degree of structural ordering, heterogeneity…)
The connection between roughness of a colored surface and material appearance is well explored: the micro-facet model (or Cook-Torrance model) connects these two properties and is widely used both in research and in the industry, but this model neglects the light/matter interactions occurring at atomic scale (diffraction for example).

The goal in this thesis is to study the relationship between the physicochemical properties of a material and its optical properties. In a first step, we plan to focus on dry powdered pigments, as this research domain is both relatively unexplored and with many potential applications, especially in cultural heritage, for the study of cave paintings. Color changes of a mineral pigment often occurs when milled into powder. Hematite (Fe_2O_3), a commonly used pigment, is well known to appear black in its bulk crystalline form and red when ground into a powder. It will be chosen as a case study. Powders of synthetic hematite (prepared with different grain size and morphology) and natural hematite (milled at different grain sizes) will be characterized by microcopy, spectroscopy and structural techniques. Models, integrating these analytical results, will be developed in order to generate photorealistic pictures able to restitute the color changes of the powders.

In subsequent steps, we will extend the analytical strategy and the models to other materials in order to be able to handle the case of historical artefacts degraded over time. Recently, metallic decorations (often very degraded) have been identified on medieval sculptures. Oxidation of original metal (or alloy) will be investigated by identification of the nature of the degraded phases of historical samples. Computer-generated pictures will have to take into account the nature of these degraded phases, their spatial organization and will aim to reproducing the appearance of the artwork for different degrees of degradation.

This PhD project will be hosted by the LJK Research Laboratory team (Maverick team) and Néel Institute (MRS team): the PhD student will be mainly located in one of these two laboratories, in close collaboration with the other (for meetings and regular stays).

This project is, by nature, cross-disciplinary; the candidate will have to learn tools and practice from both Computer Graphics and material science. We are looking for a candidate with a strong background in either of the two disciplines, willing to learn the tools and methods of the other discipline.

ELIGIBILITY CRITERIA
Applicants:
- must hold a Master's degree (or be about to earn one) or have a university degree equivalent to a European Master's (5-year duration) in either physics, materials science, chemistry or computer science. Strong knowledge in optics and skills in programming (C/C++) are desirable.

Applicants will have to send an application letter in English and attach:
- Their last diploma
- Their CV
- A short presentation of their scientific project (2 to 3 pages max)
- Letters of recommendation are welcome.

Addresses to send their application: Nicolas.Holzschuch@inria.fr and pauline.martinetto@neel.cnrs.fr

Univ. Grenoble Alpes
Université de l'innovation

SELECTION PROCESS

Application deadline: **June 11, 2018** at 17:00 (CET)

Applications will be evaluated through a three-step process:

1. Eligibility check of applications in early June 2018
2. 1st round of selection: the applications will be evaluated by a Review Board in June 2018. Results will be given by June 15, 2018.
3. 2nd round of selection: shortlisted candidates will be invited for an interview session in Grenoble from mid-June 2018 (if necessary).
4. Final results will be given in early July, after study of the selected applications by the doctoral school's.

TYPE of CONTRACT: temporary-3 years of doctoral contract
JOB STATUS: Full time
HOURS PER WEEK: 35
OFFER STARTING DATE: October 1, 2018
APPLICATION DEADLINE: **June 11, 2018** at 17:00 (CET)
Salary: between 1768.55 € and 2100 € brut per month (depending on complementary activity or not)